



The Jupiter Environment Tool

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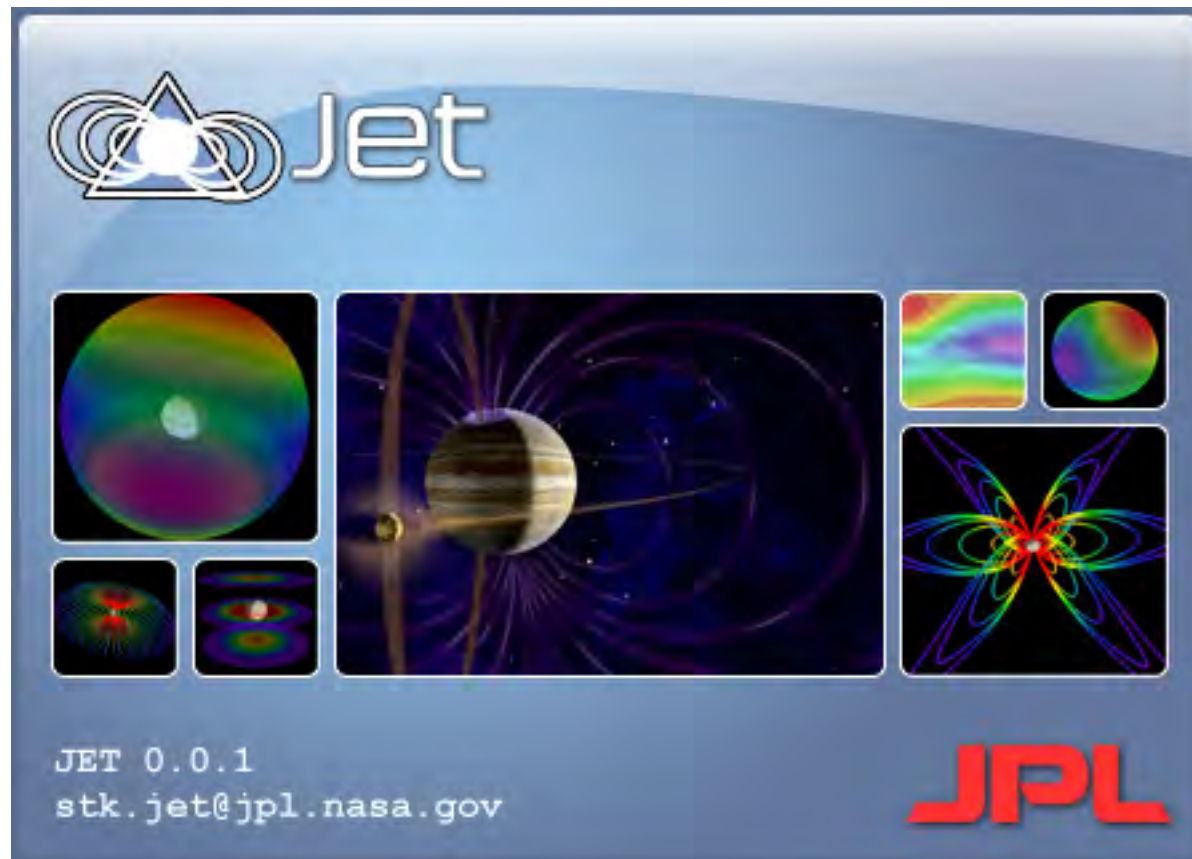
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The Jupiter Environment Tool (JET)



Custom User Interface Plugin for STK

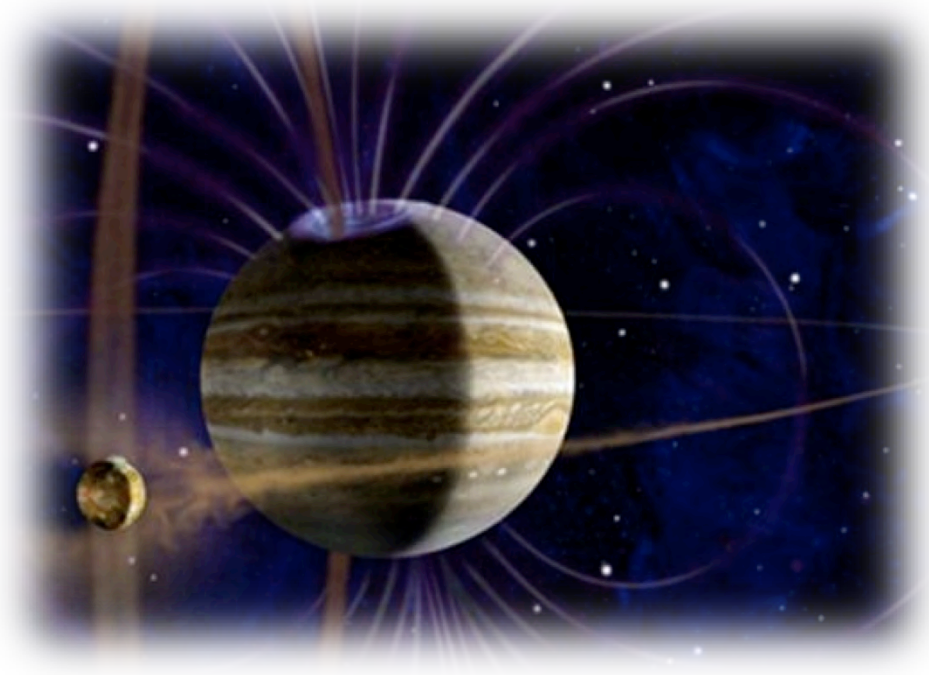




The Europa Jupiter System Mission wanted:

- Geometric analysis with respect to:
& Visualization of:

- Magnetosphere
- Radiation Field
- Plasma & Neutral Tori
- Rings / Dust / Small Bodies
- Satellite Atmospheres



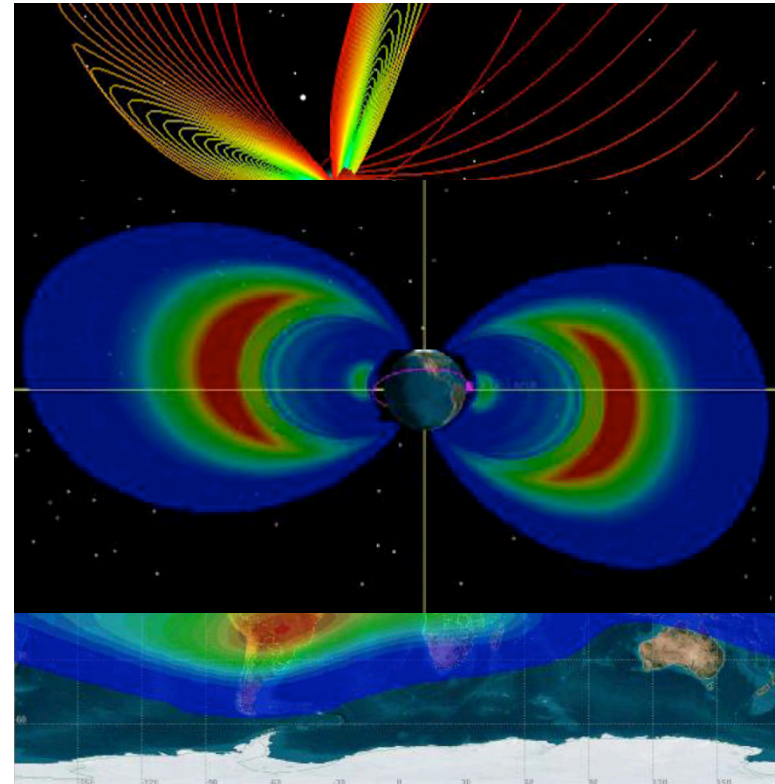
- Fast turn-around Jovian tour radiation dose estimation



AGI / AER released the Space Environment and Effects Tool (SEET)

– Modules

- Magnetic Field
- South Atlantic Anomaly
- Radiation Environment
- Particle Impacts
- Vehicle Temperature



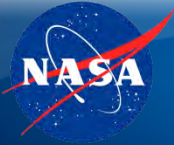
- Only for the Earth, with no planned extensions to other planets



Development History



- **Development started in July 2010, all in-house at JPL**
- **Primary Goal: Integrate Jovian magnetic field models into STK as a proof-of-concept for further environment model integration**
- **Small team of 3 JPL employees & 3 summer hires**
 - Erick Sturm, JPL
Team Lead & Developer – Fortran/C# Translation, GUI Design
 - Michael Kokorowski, JPL
Magnetic Field Model Expert – Model Validation
 - James Biehl, JPL
Developer – XML Schema, GUI Save/Load Routines
 - Kenneth Donahue, MIT (now at JPL)
Developer – Plugin Architecture, Primitive Renderers
 - Jordan Boedeker, Iowa State University
Developer – Custom Vectors
 - Cedrick Ngalande, USC (now at Microcosm, Inc.)
Developer – Plugin-FORTRAN Interface



Development Status (After ~1 Year)



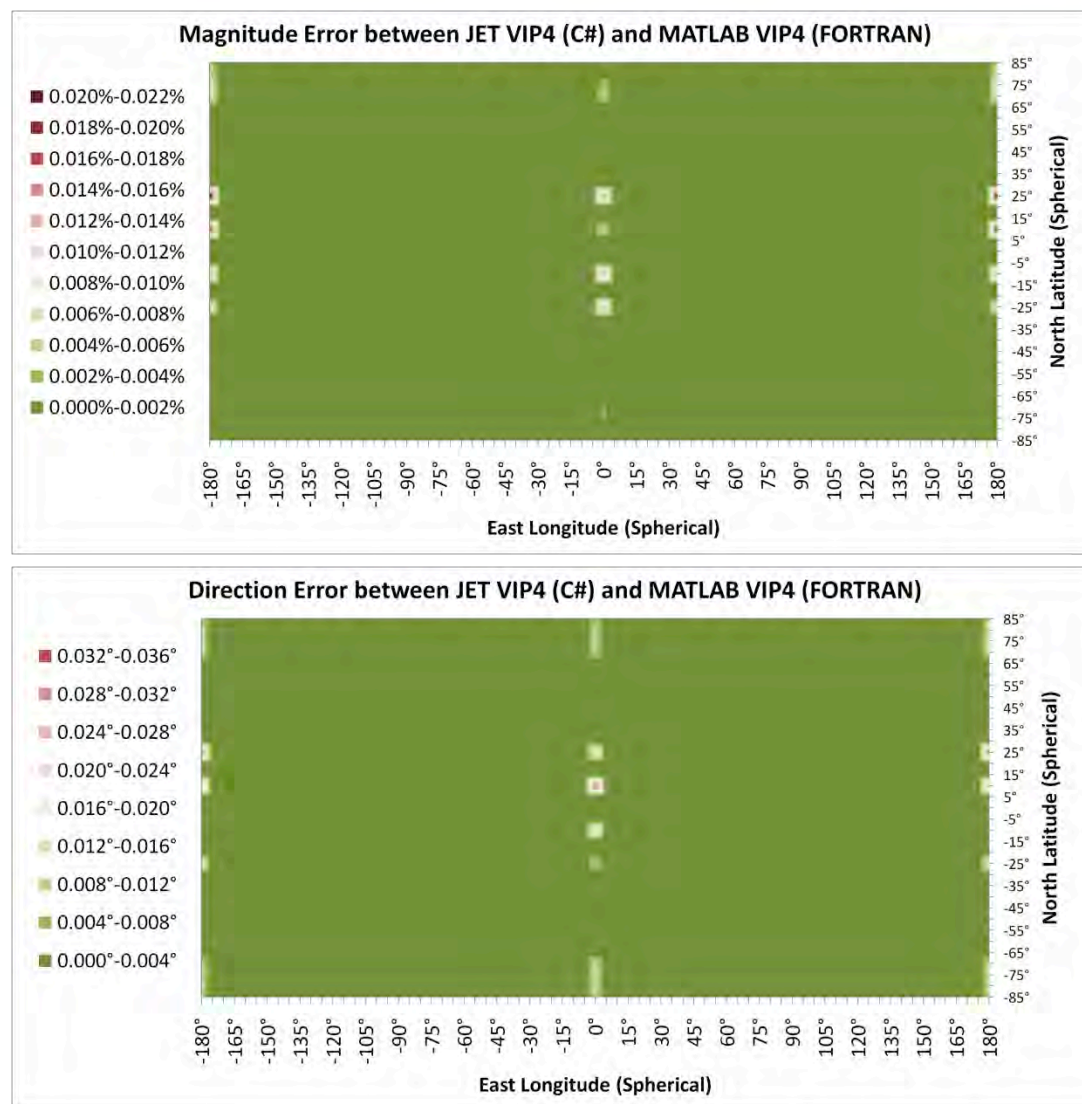
- **Three magnetic field models integrated into Plugin**
 - Simple dipole model
 - VIP4 model (original Fortran code)
 - VIP4 model (translated into C#)
- **Integrated user interface window, toolbar, & context menu**
- **Four visualization types rendered in the 3D Window**
 - Field lines
 - Flux-tube footprint ovals (auroral ovals)
 - Plane contours
 - Spherical-sector contours
- **Area & line target generation from footprint oval primitives**
- **Addition of three custom vectors in the VGT**
 - Magnetic field vector
 - Field-line/central-body intersection vectors (North & South)
- **Custom report & graph templates**
- **Compiled Help chm file with context-sensitive access from GUI**
- **Packaged as an msi file for quick & easy installation**



Magnetic Field Model Validation



- Validated Plugin VIP4 C# & F models against original F code
- Sampled points on a 5° Lat/Lon Grid
- Sampled at 1, 1.1, 1.25, 1.5, 2, 5, & 10 R_J
- Calculated error in magnitude & direction of magnetic field vector
- Max Errors:
 - 0.022% Magnitude
 - 0.036° Direction





JET User Interfaces within STK



The screenshot displays the STK 9 interface with the JET 1 - Jupiter window open. The Object Browser on the left shows the JET_Tutorial hierarchy. A red arrow points from the JET icon in the Object Browser to the JET 1 - Jupiter window.

JET 1 - Jupiter Window:

- Options Tab:** Contains a table for Model Options and Color Options.
- Model Options Table:**

Model	Body Lines	Object Lines	Foot Prints	Planes	Spheres
Dipole	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
VIP4	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
VIP4-F	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

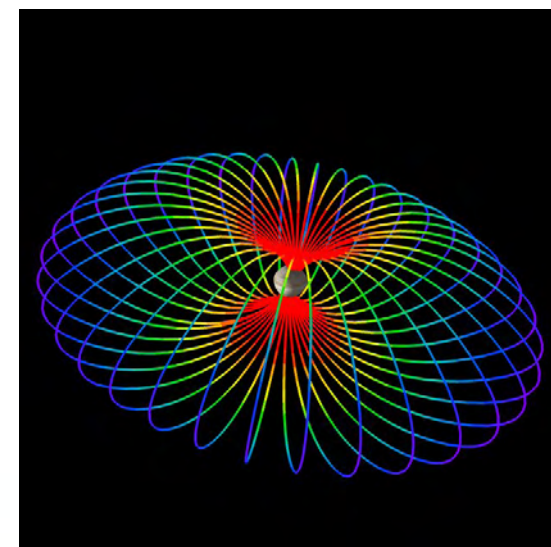
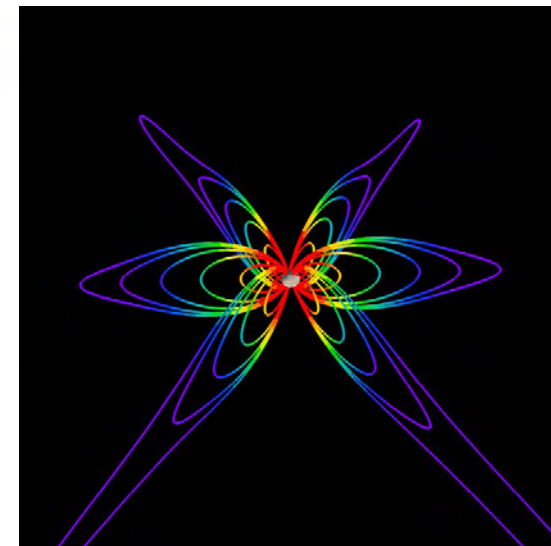
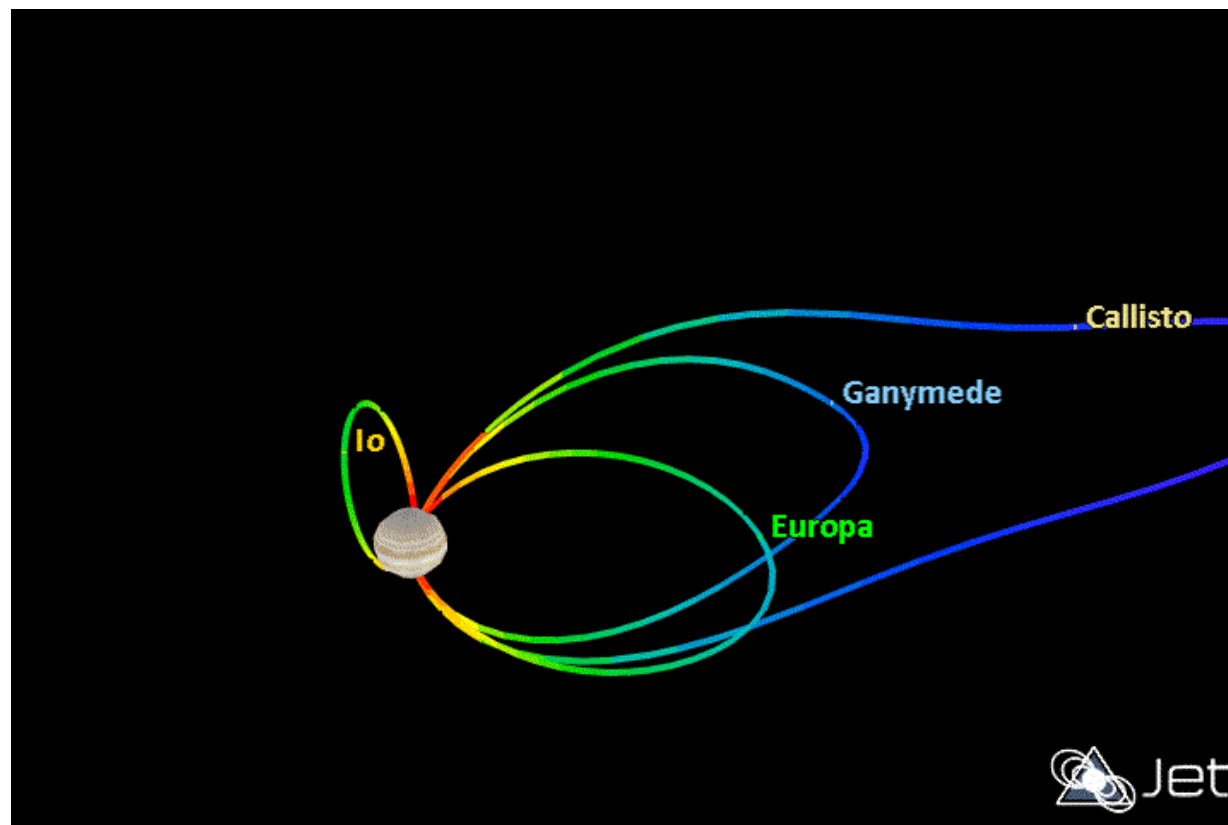
- Color Options:**
 - Color Mode: Magnitude
 - Color Scale Type: Log
 - Color Scale Min (Gauss): 0.001
 - Color Scale Max (Gauss): 0.1
 - Gradient Color Editor: Color, Location, Delete Color, Reverse Colors, Load Gradient
- Animation Options:**
 - ☐ Render during animation
 - Time steps between renders: 1

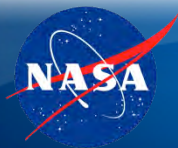
Object Browser:

- Properties menu is open, showing options like Zoom To, Access..., Deck Access..., Coverage..., Vector Geometry Tool, Quick Report Manager..., Report & Graph Manager..., Export Ephemeris/Attitude..., Satellite, Satellite Plugins, Cut, Copy, Paste, Delete, Rename, Hide Toolbar.
- Satellite Plugins sub-menu is open, showing options like Add Object Timeline, Open JET GUI, Add Jupiter Dipole Vectors, Add Jupiter VIP4 Vectors, Add Jupiter VIP4 (Fortran) Vectors, Add Ganymede Dipole Vectors.

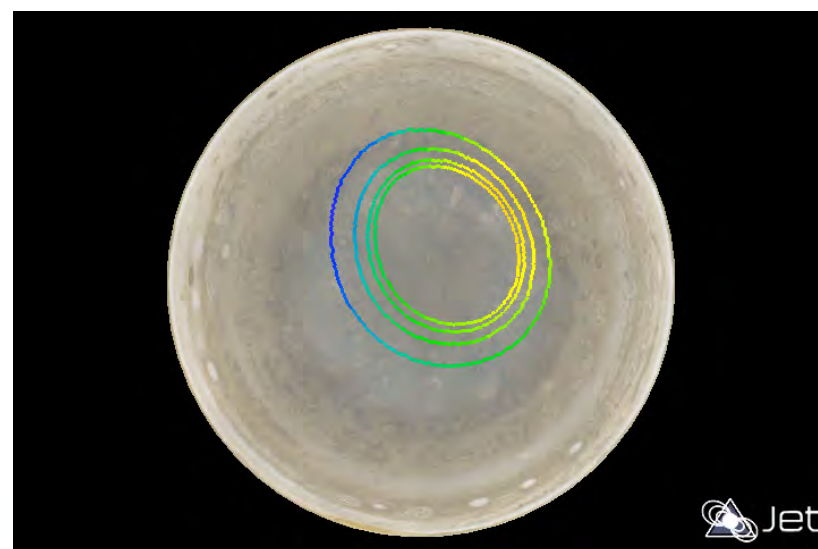
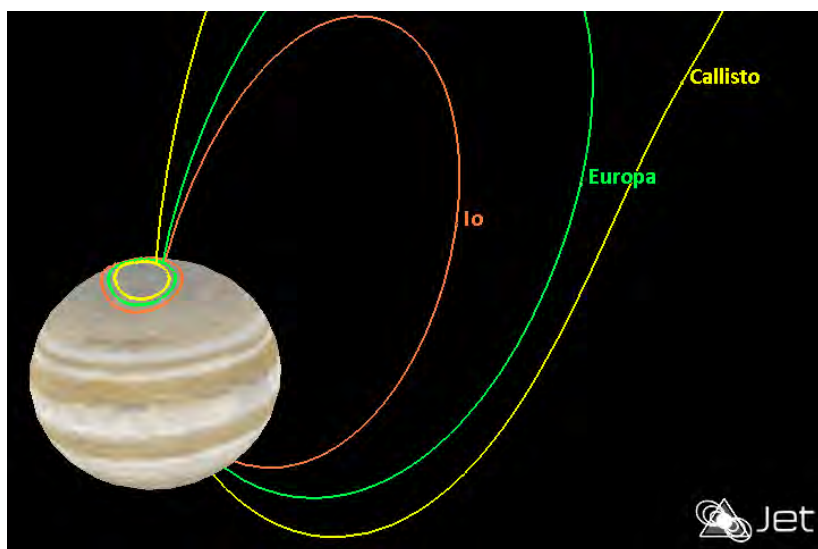
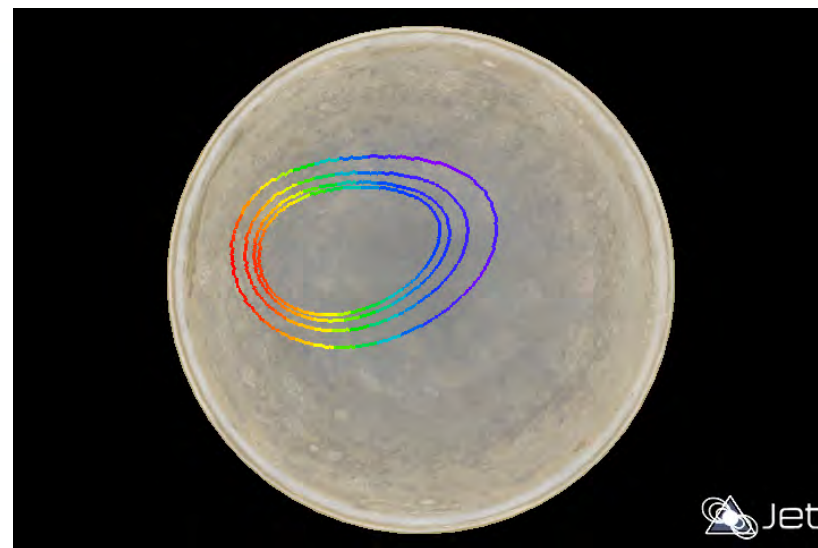
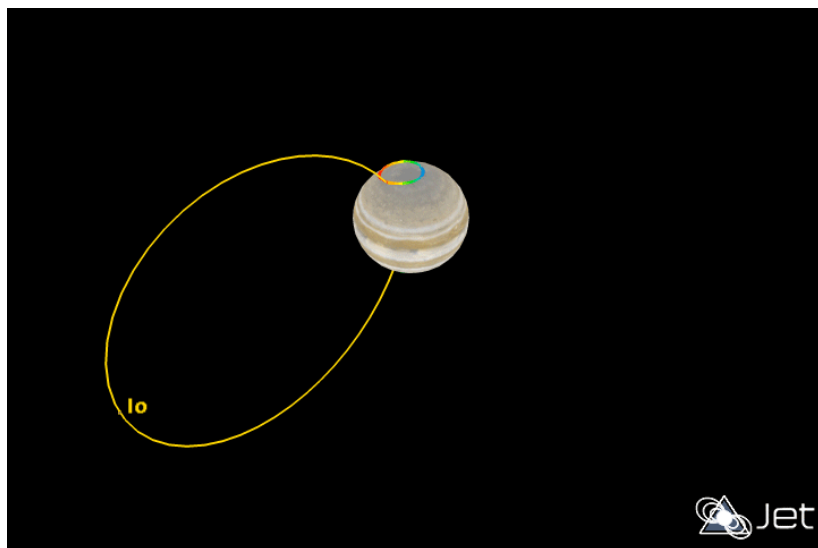


Visualization: Field Lines



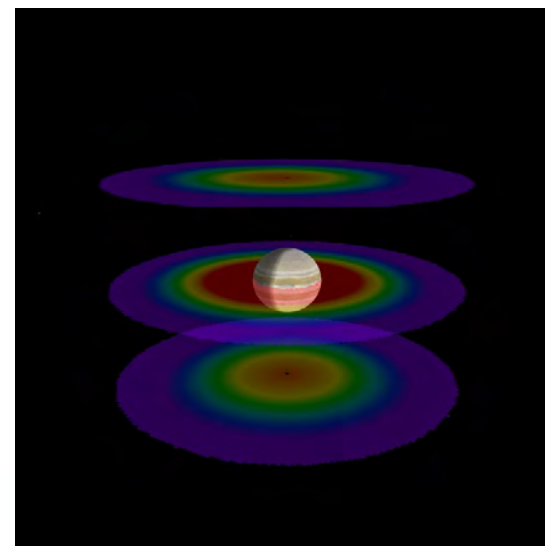
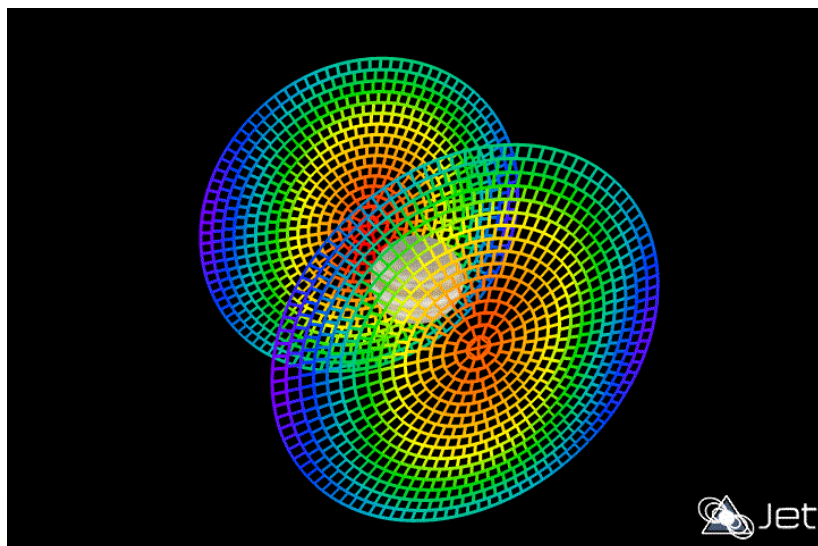
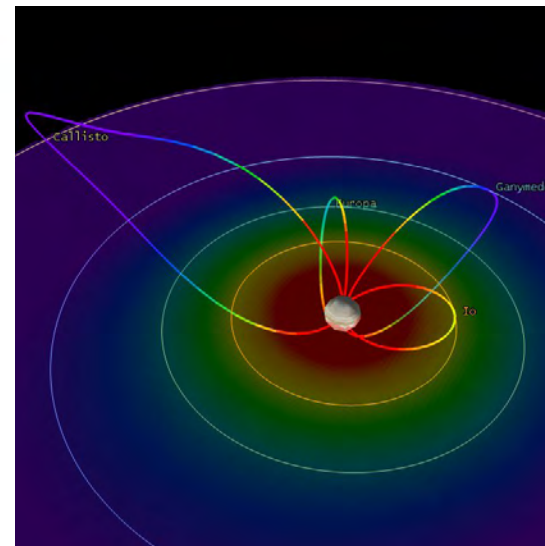
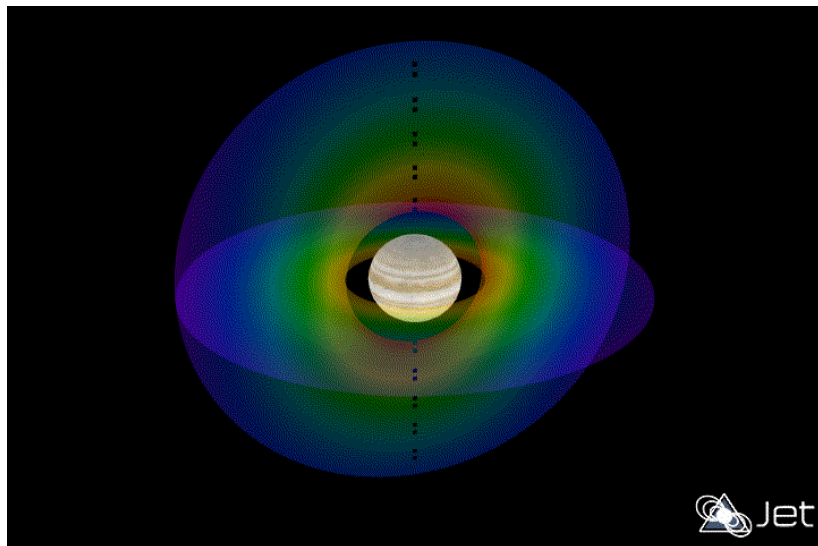


Visualization: Footprint Ovals



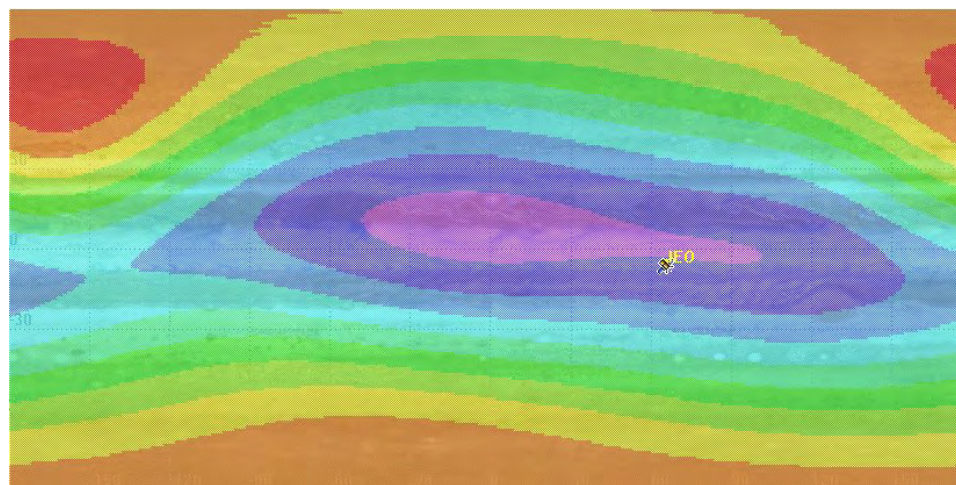
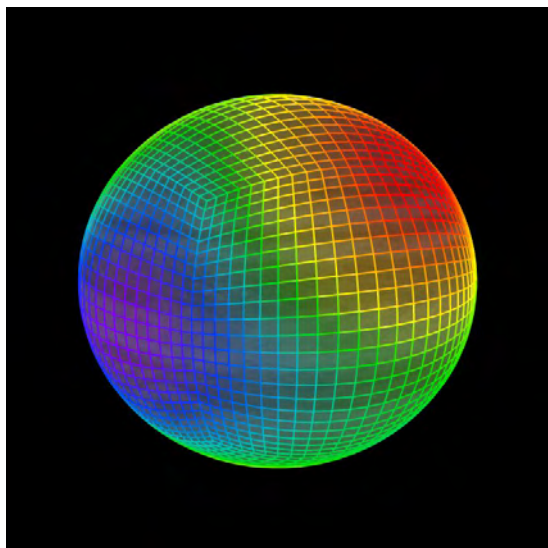
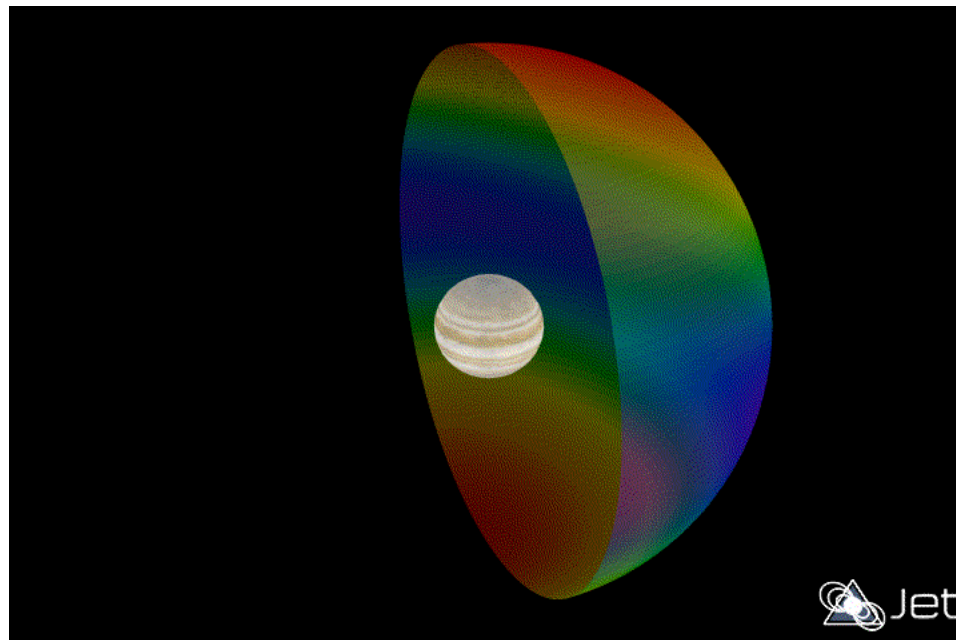
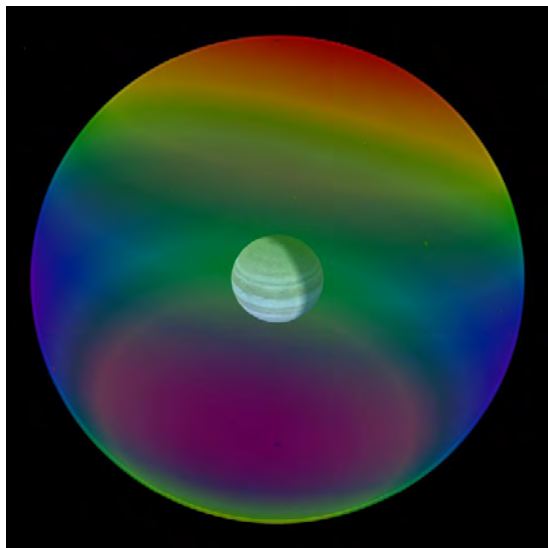


Visualization: Planar Contours



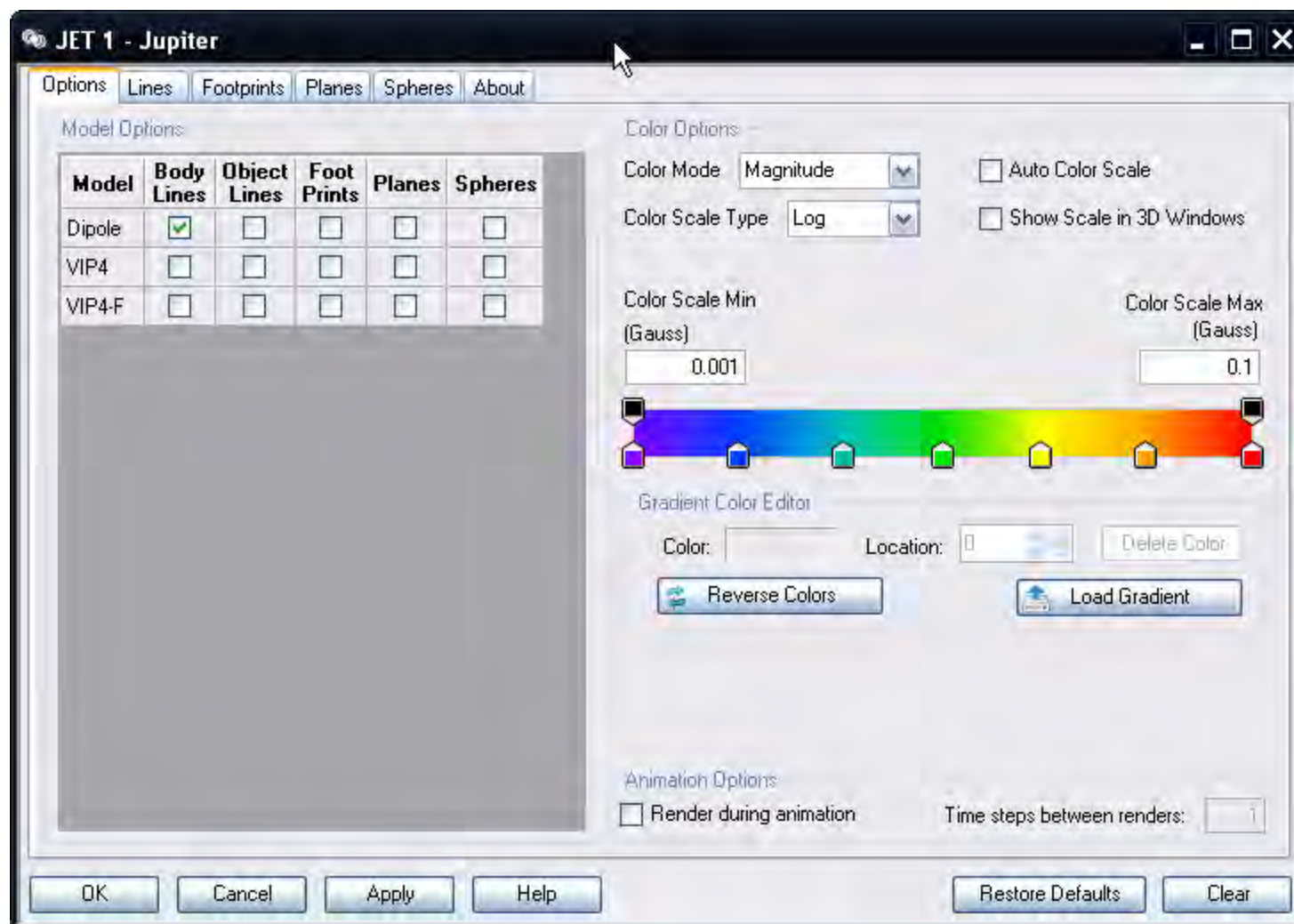


Visualization: Spherical Contours



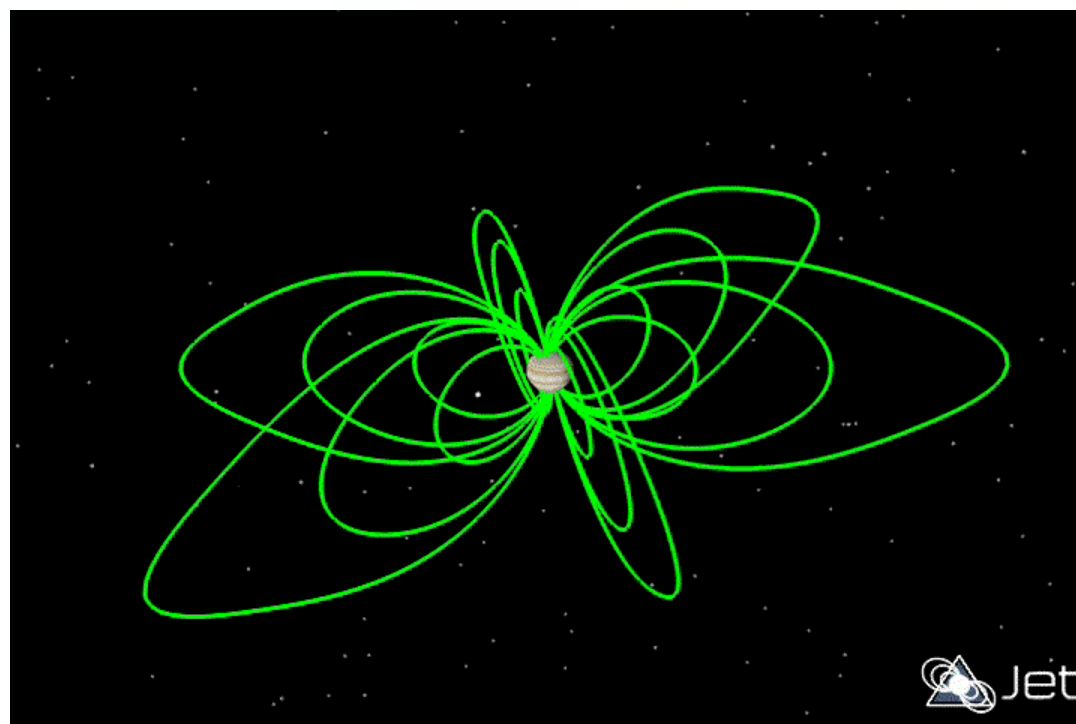
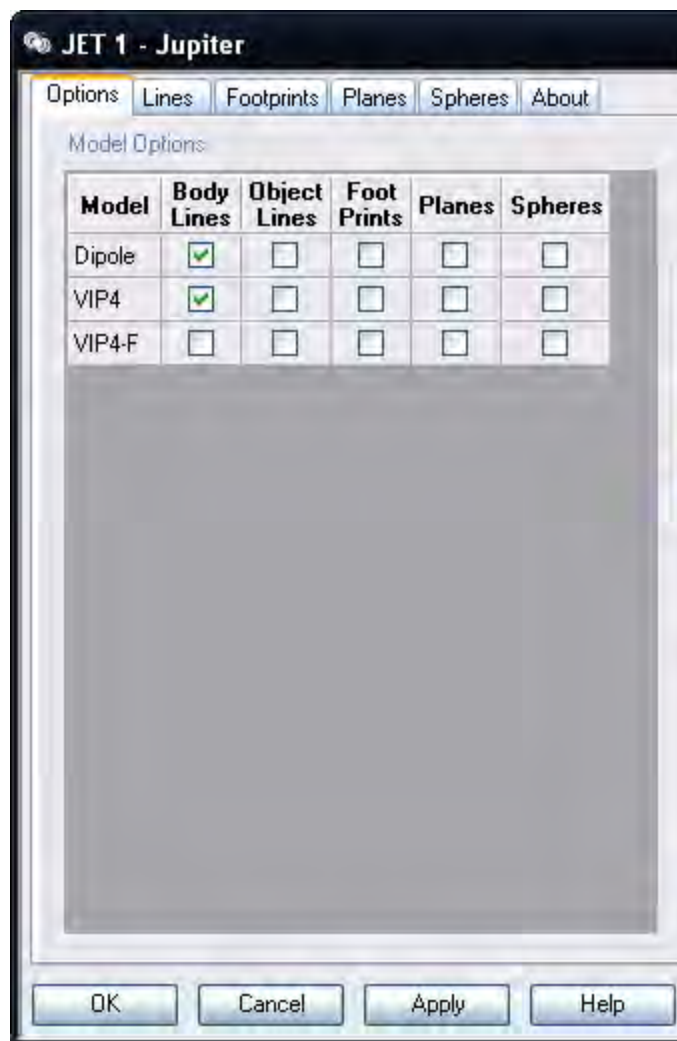


Visualization: Options



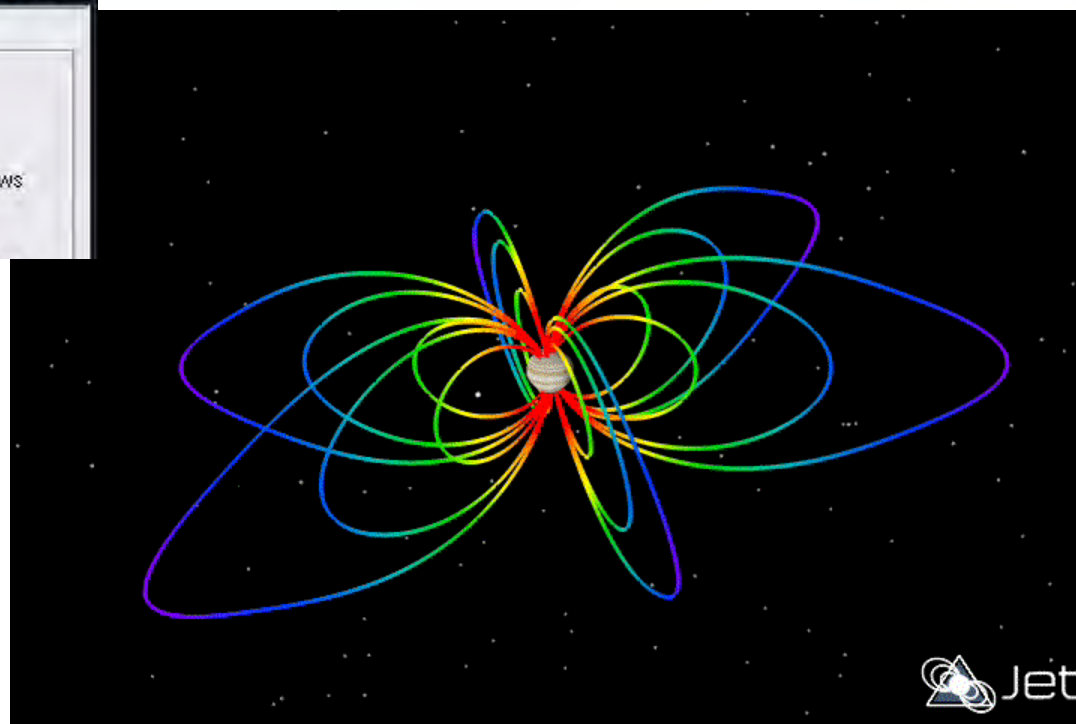
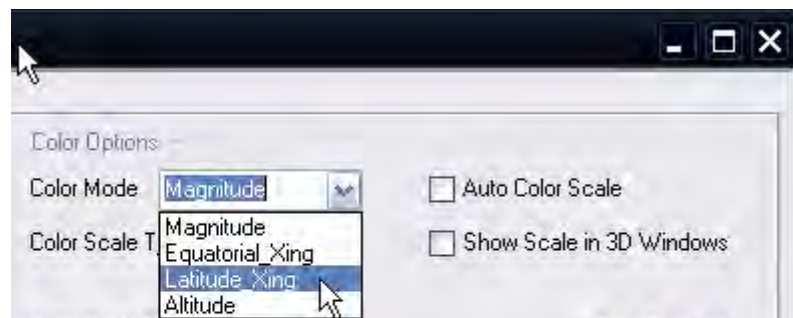


Visualization: Options



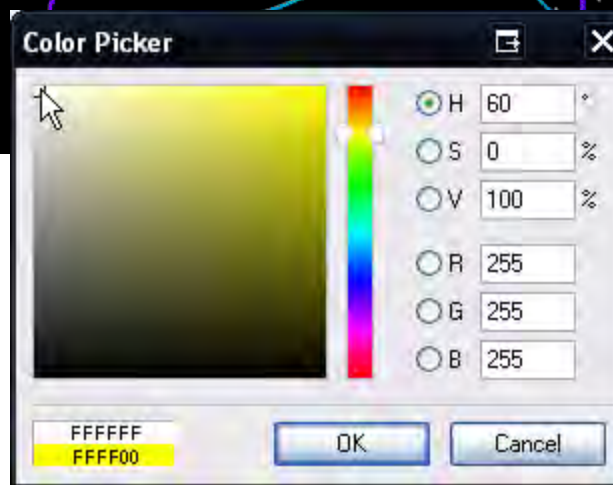
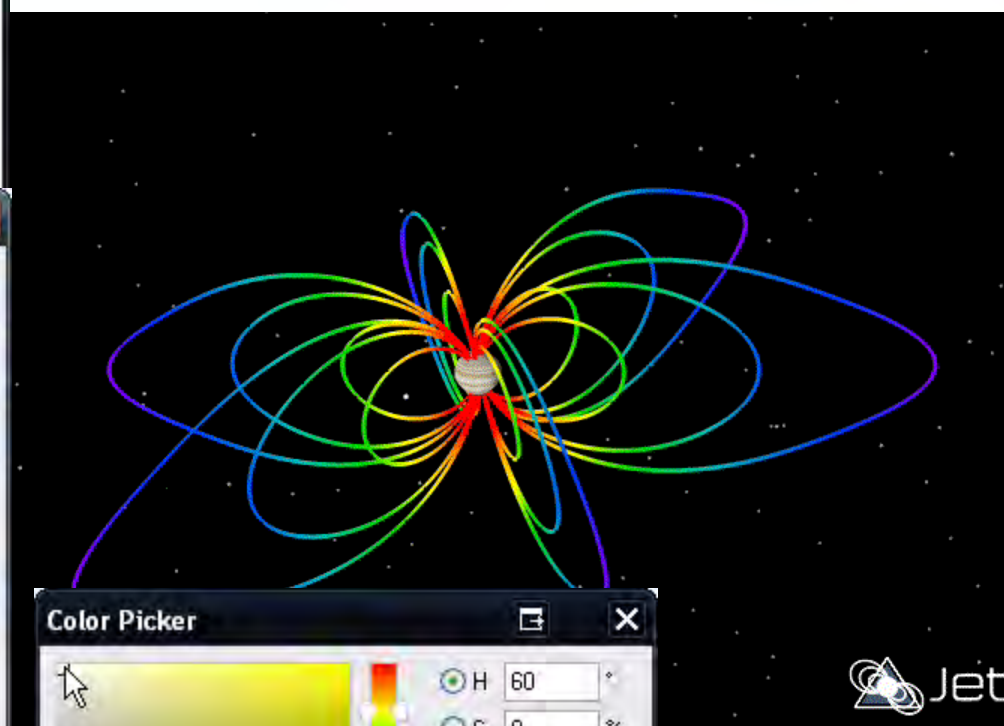
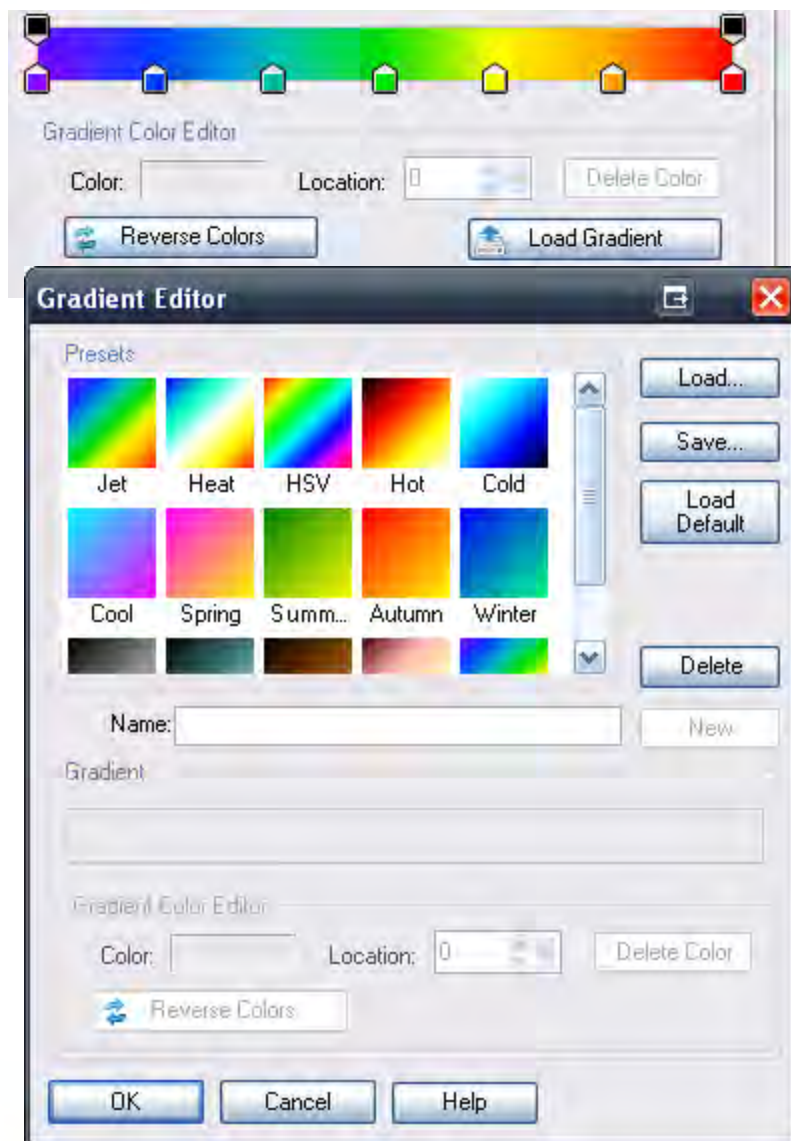


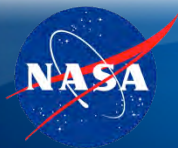
Visualization: Options





Visualization: Options





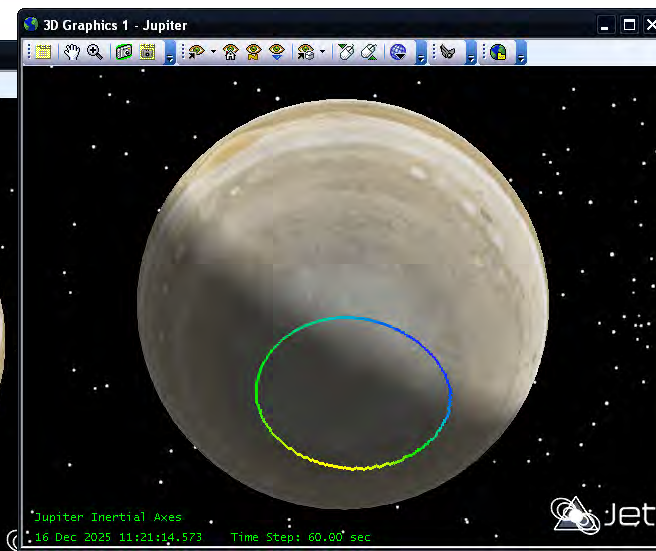


Footprint Oval Area & Line Targets



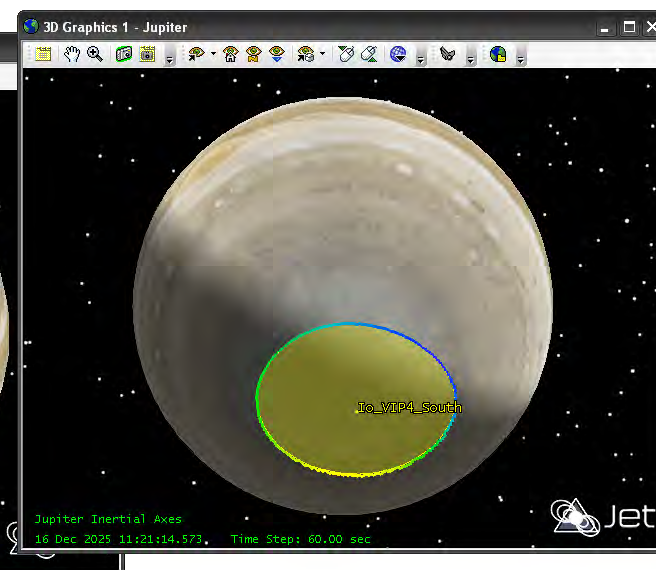
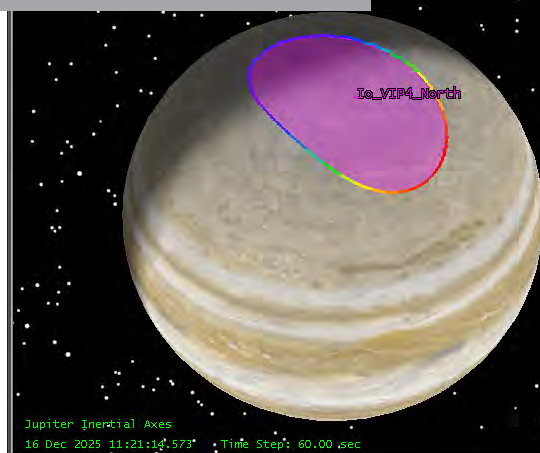
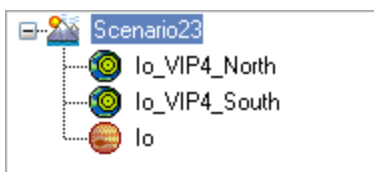
Object Footprints

Objects	Track		Show	Color	Line Width	Line Style	Line Res.	Color Res.
Planet: Io	Lead			<input checked="" type="checkbox"/>	<input type="checkbox"/>	Medium	Solid	Medium



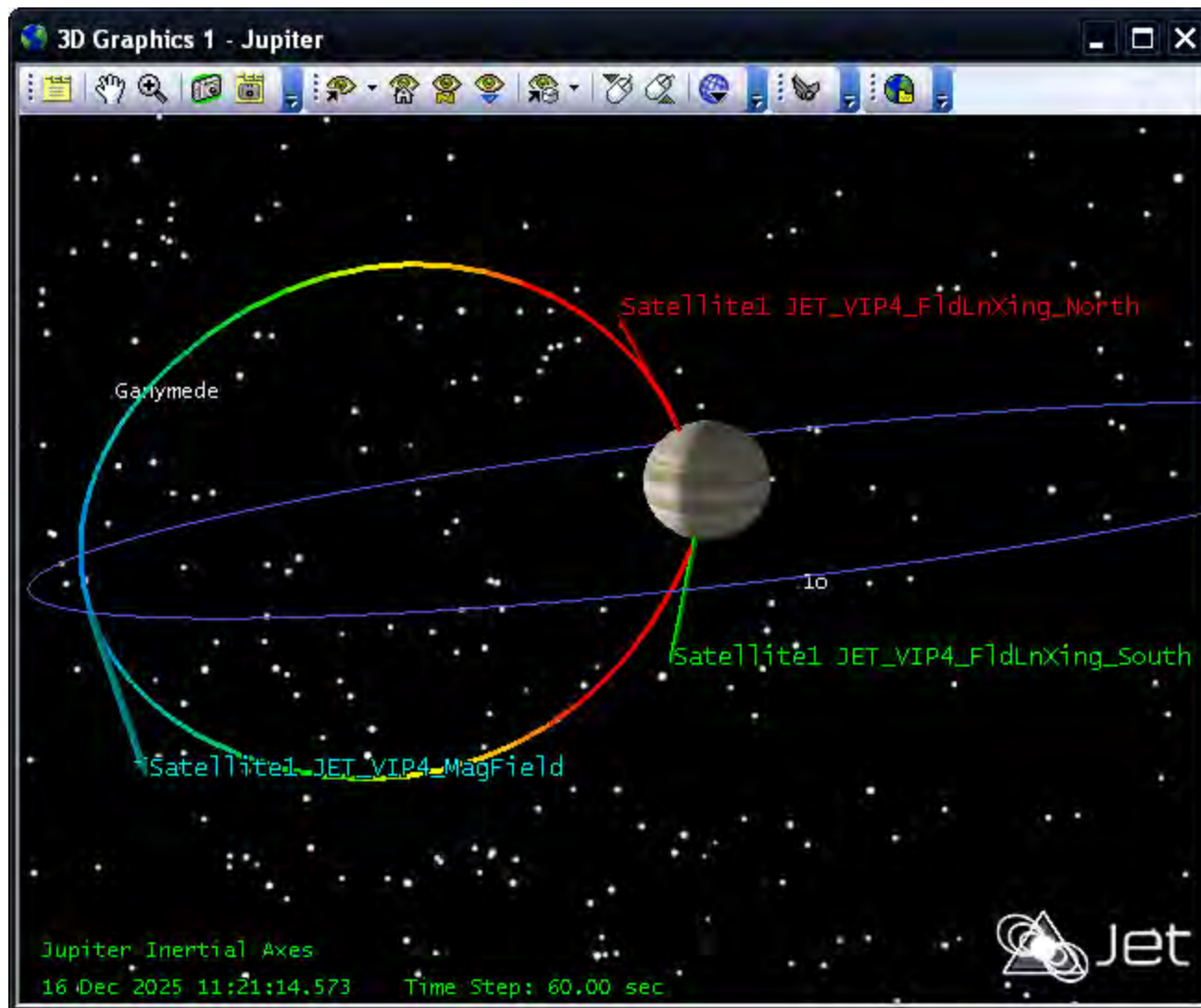
Object Footprints

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Planet: Io	Lead			<input type="checkbox"/>	<input type="checkbox"/>	Medium	Solid	Medium



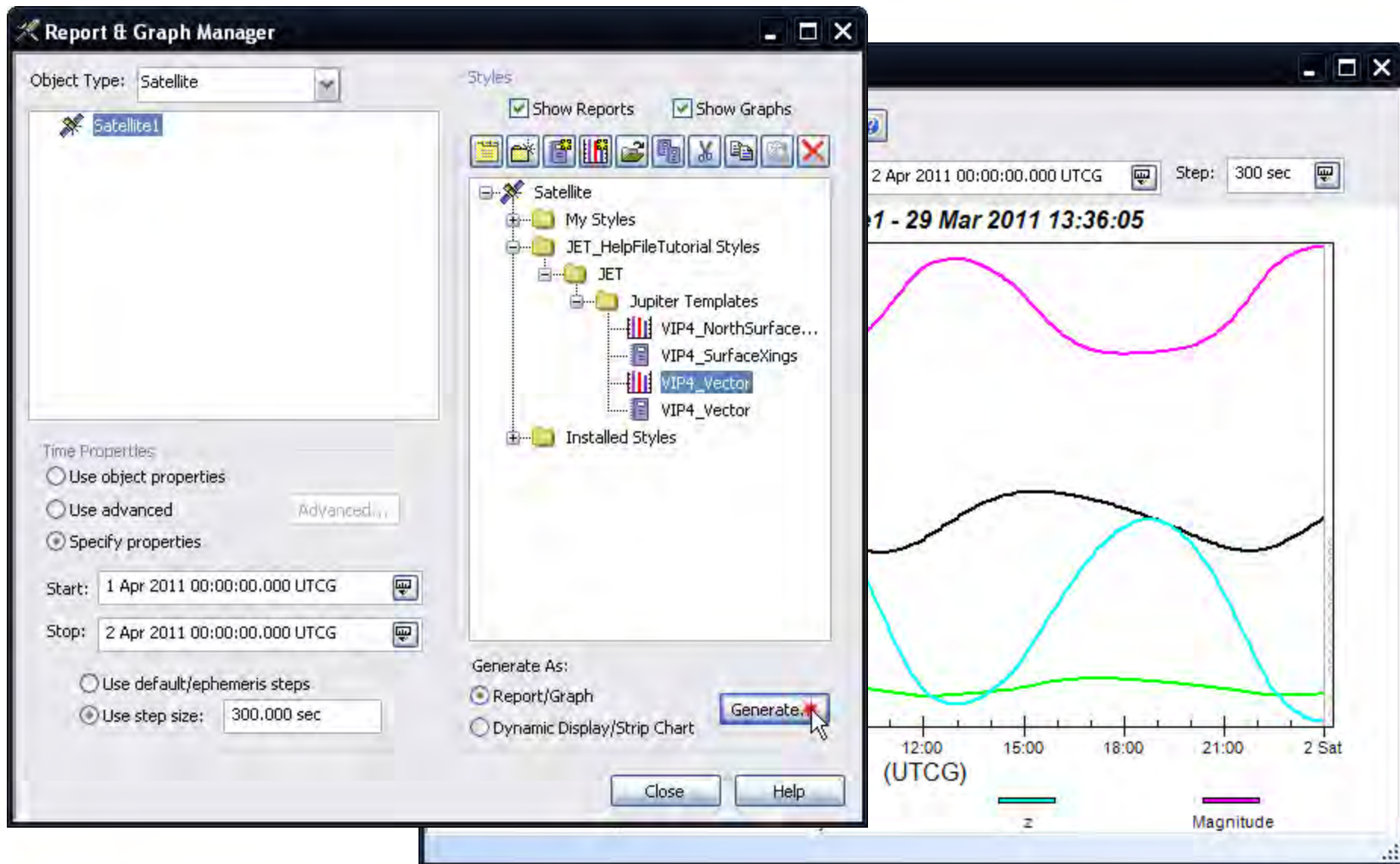


Custom Magnetic Field Vectors





Custom Report & Graph Templates





Compiled Help File

JET Help

Hide Back Forward Home Print Options

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 - Release Notes
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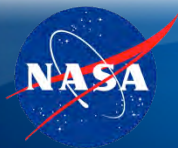
JET 0.0.1
stk.jet@jpl.nasa.gov

JPL

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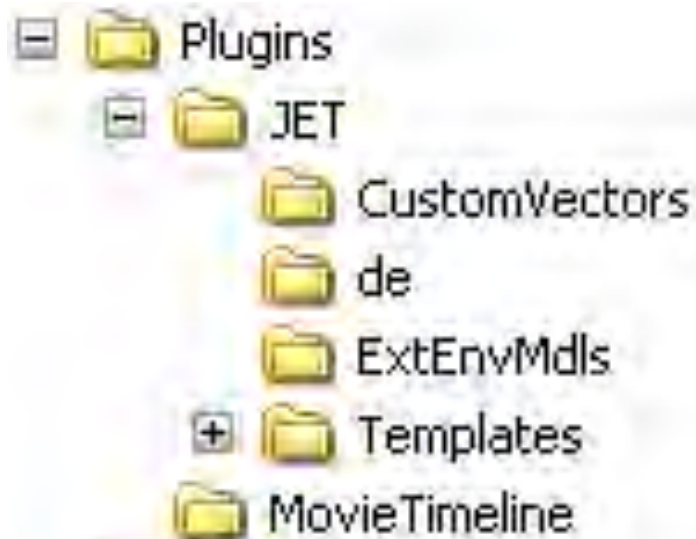
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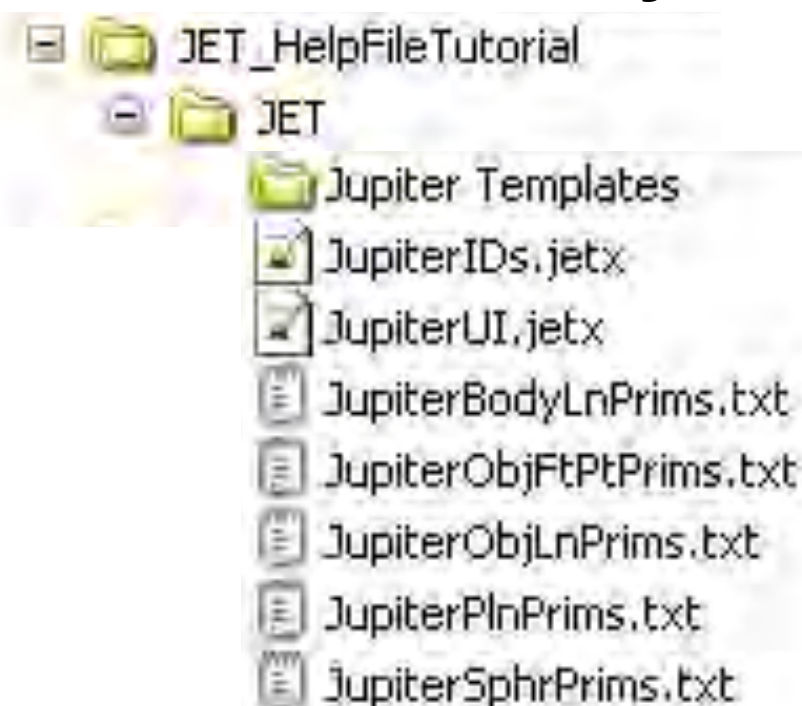
JET File Structure



STK Install Directory

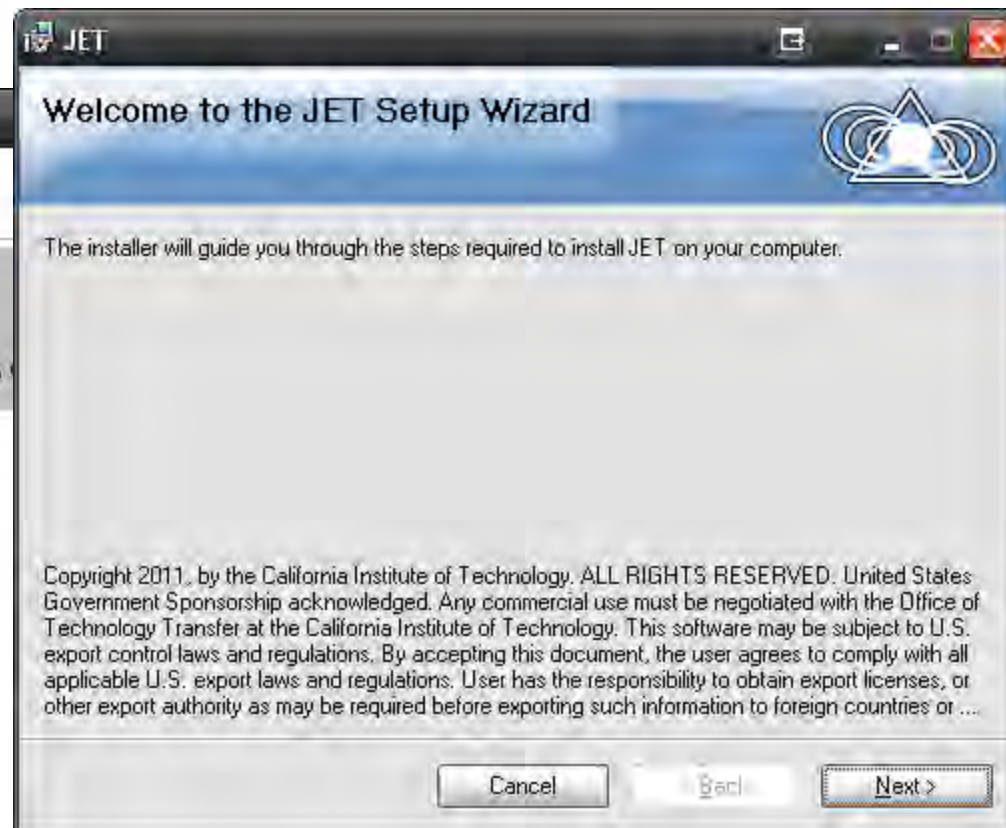


Scenario Directory



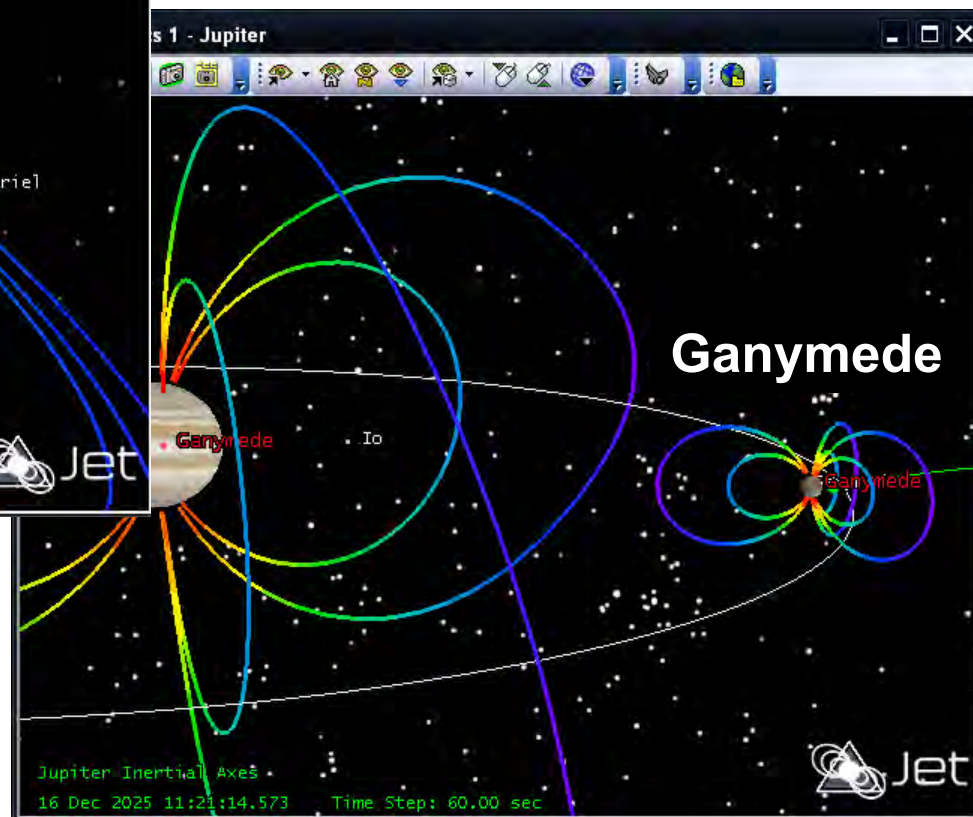
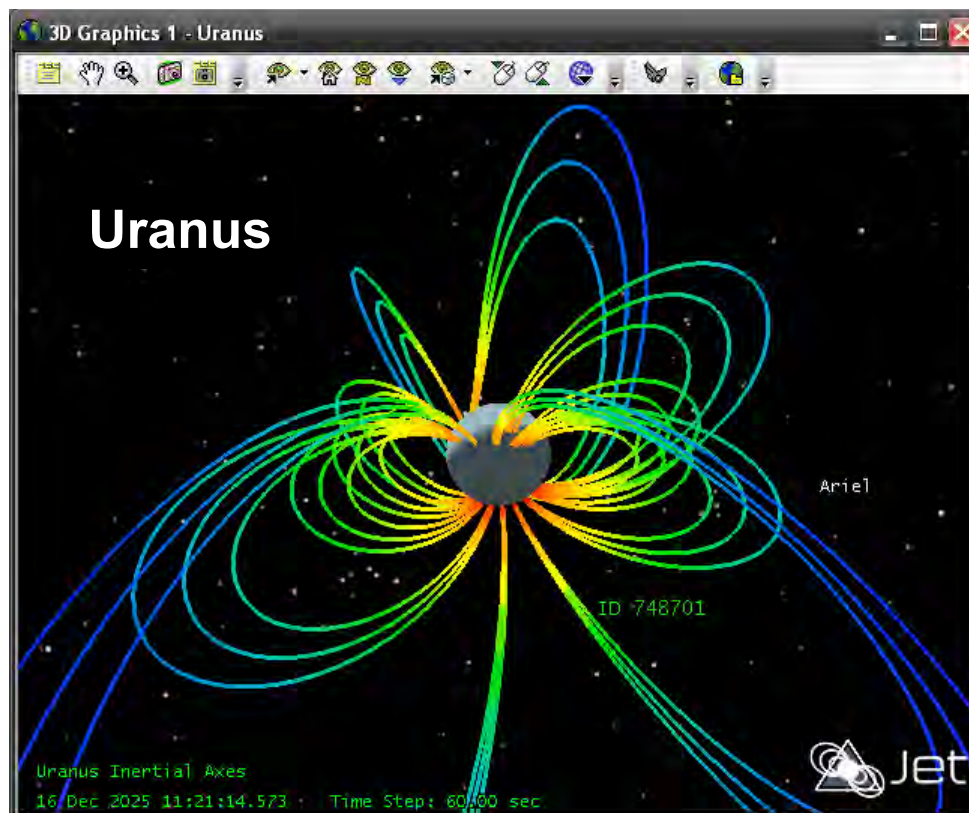


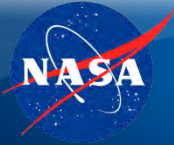
Installation Package





Beyond Jupiter





Future Work




- **Extend to other environment models**
 - Radiation Field
 - Plasma & Neutral Tori
 - Rings / Dust / Small Bodies
 - Satellite Atmospheres

- **Extend to other planets**

- **Clear for public release**
 - Currently releasable on a case-by-case basis
 - For more information on obtaining a copy email:
stk.jet@jpl.nasa.gov



Questions?

 Jet

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